SECTION 6

THOROUGHFARE AND CIRCULATION DESIGN REQUIREMENTS

SECTION 6 – THOROUGHFARE AND CIRCULATION DESIGN REQUIREMENTS

6.01 GENERAL:

A. The arrangement, character, extent, width and location of all streets shall be in conformity with the City's Thoroughfare Plan and Comprehensive Plan, and should be considered in their relation to existing and planned streets, topographical and environmental considerations, scenic views and the land uses proposed to be served by such streets.

B. In the interpretation and application of the provisions of these standards, it is the intention of the City Council that the principles, standards and requirements provided herein shall be minimum requirements for the development of property in the City of Frisco, and where other ordinances of the City are more restrictive, such other ordinances shall control.

C. All deviations from the provisions presented herein shall be approved by the Frisco City Staff which includes, the City Manager, City Engineer, Director of Development Services, Director of Public Works, City Fire Chief, and any others deemed necessary by the City Manager.

6.02 STREET DESIGN:

A. Thoroughfare Definitions - The City of Frisco recognizes four basic classifications of public roadways that include freeways, thoroughfares, collectors, and local streets as identified in the transportation element of the Comprehensive Plan. Each class provides a certain degree of continuity, capacity, and accessibility to adjacent land uses. While differentiated by function, there is also a variance in geometric design. Table 6.1 summarizes the general design criteria of roadways within Frisco. The typical cross-sections are depicted in Figures 6.1 and 6.2.

B. Roadway Geometrics - Geometrics of city streets may be defined as the geometry of the pavement and curb areas that govern the movement of traffic within the confines of the rights-of-way (ROW). Included in the geometrics are pavement width, degree of curvature, width of traffic lanes, median nose radii, curb radii at street intersections, cross fall, crown height, pavement thickness and geometric shapes of islands separating traffic movements and other features.

1. Design Speed - The design speed is a primary factor in the horizontal and vertical alignment of roadways. Design features such as curvature, super-elevation, turning movement radii and sight distance affects roadway lane width, pavement width, pavement cross-fall, pavement crown and clearances. The design speeds depicted shall be used where existing ground slopes are less than six percent (6%). Refer to Table 6.1.

2. Grades - Roadway grades shall be a minimum of six-tenths percent (0.6%) on order to insure proper flow of surface drainage toward inlets and a maximum of six percent (6%). Steeper grades may be permitted on local residential streets and where required by topographical features, as approved by the City Engineer or his/her designee.

3. Roadway Centerline - Roadways shall be placed in the center of the ROW, but may be shifted slightly to avoid groupings of trees. The centerline of curves shall be tangent to the centerline of street at each end of curve.

4. Cross Fall/Crown Height – Type A and B thoroughfares shall have a minimum cross fall of one-quarter inch per foot and a maximum cross fall of three-eighths inch per foot. Type C and D thoroughfares shall have six-inch (6") parabolic crowns, Type E thoroughfares a four-inch (4") parabolic crown and Type F thoroughfares a five-inch (5") parabolic crown.

5. Pavement Thickness - All pavement and six-inch (6″) integral curb shall be a minimum 3500psi with #3 bars twenty-four inch (24″) on center. Six inches (6″) minimum of lime stabilized subgrade to reduce Plasticity Index (PI) to fifteen (15) as determined by lime series. Add one-percent (1%) for field variation. Refer to Table 6.1 for pavement thickness. If solid rock is present, waiver of lime stabilized subgrade shall be approved by the City Engineer.

TABLE 6.1: City of Frisco Thoroughfare Definitions

Criteria	Thoroughfare Class					
	Major "A"	Minor "B"	Collector-Commercial "C"	Collector-Residential "D"	Local "E"	Local [(2)(3)] "F"
Right-of-Way (ROW)	120′[(5)]	90′[(6)]	60′	60′	50′	60′
Pavement Width (face to face)	2 @ 36′	2 @ 24′	36′	36′	26′	30′
Traffic Lanes	6	4	2	2	2	2
Left Turn-lane Width	2 @ 10′	1 @ 10′	--	--	--	--
Right Turn-lane Width	11′	11′	--	--	--	--
Median Width	24′	18′	--	--	--	--
Parkway Width	12′	12′	12′	12′	12′	15′
Minimum Pavement Thickness[(7)]	8″	8″	7″	6″	6″	6″
Design Speed, V (MPH)	50	45	30	30	25	25
Minimum Grade	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%
Maximum Grade	6%	6%	6%	6%	6%	6%
Min. Horizontal Radii[(1)]	1,400′	1,050′	450′	450′	250′[(4)]	250′[(4)]
Min. Tangent Between Curves	100′	100′	100′	100′	--	--
Min. Length of Crest Curve	See Table 6.3					
Min. Length of Sag	See Table 6.4					
Stopping Sight Distance	475′	400′	200′	200′	150′	150′
Parking	None	None	None	Permitted	Permitted	Permitted
Volume Range (VPD)	36-45,000	20-28,000	12-18,000	6-12,000	--	--

(1) Absolute minimum based on –2% cross slope.
(2) Local Street with front-entry access.
(3) Tree per lot required in parkway. (Rear entry product will have a 26′ street width, unless otherwise noted)
(4) May be reduced to two hundred feet (200′) radius at mid-block locations provided that it is shown that the general public safety is not compromised. A curve, with a radius less than two hundred fifty feet (250′), must be a minimum of three hundred feet (300′) from a street or alley intersection.
(5) 140′ ROW at intersections with Type A or B thoroughfare.
(6) 110′ ROW at intersections with Type A or B thoroughfare.
(7) Thickness shall be based on the geotechnical soils report.

C. Minimum Horizontal Design Radius:

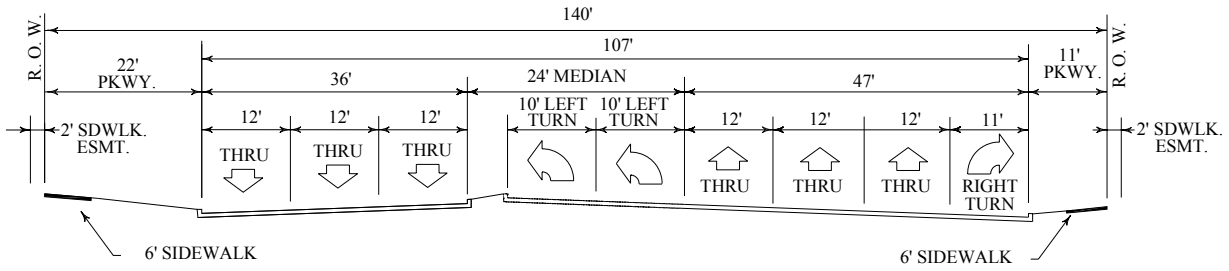
1. The minimum centerline radius is a function of design speed, super-elevation and vehicle side friction. Side friction is the force that keeps a vehicle from sliding off of the roadway. The minimum acceptable horizontal centerline radius is calculated using the following equation:

$$R(ft.) = \frac{V^2}{15(e+f)}$$

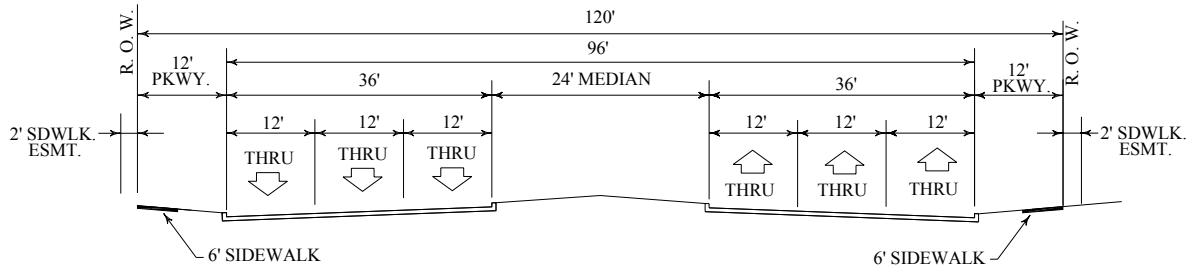
where: R = centerline radius (ft); V = vehicle design speed (MPH); e = rate of roadway super-elevation, (ft/ft); f = side friction factor.

2. The minimum acceptable horizontal radius is shown in Table 6.2. The maximum length of a horizontal curve on Type C, D, E, or F roadways shall not exceed 1.6 times the centerline radius for a radius of two hundred feet (200′) or greater.

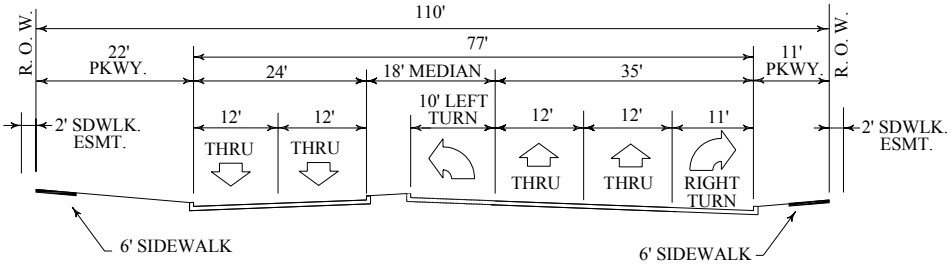
Major Thoroughfare 'A' (Intersection)



Major Thoroughfare 'A' (Midblock)



Minor Thoroughfare 'B' (Intersection)



Minor Thoroughfare 'B' (Midblock)

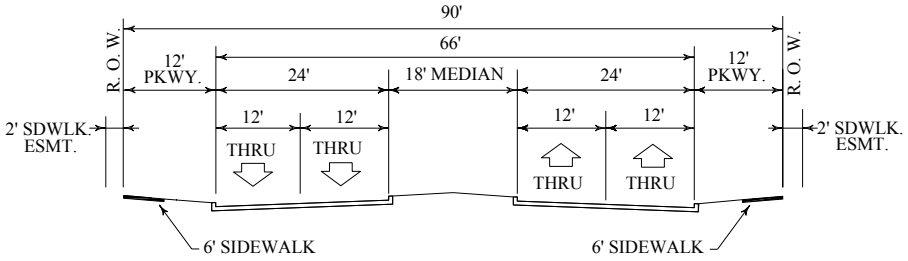
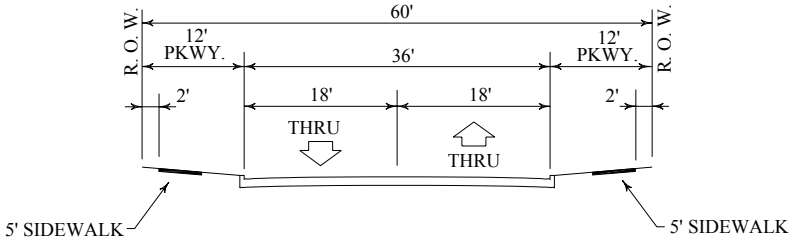
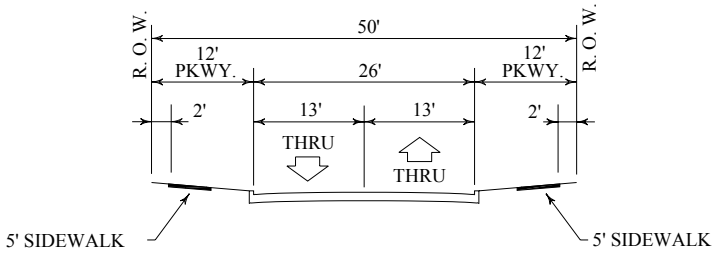


FIGURE 6.1: Cross Sections for Thoroughfares Types A and B

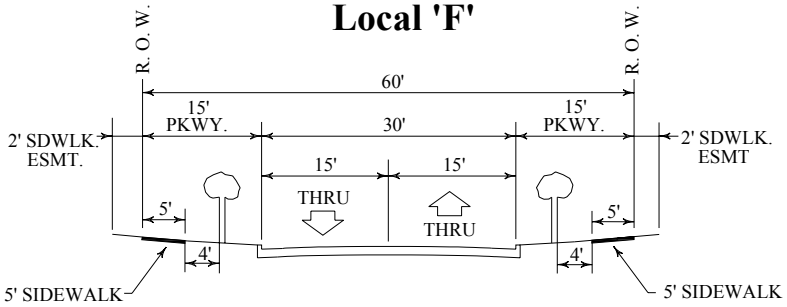
Collector-Commercial 'C'
and
Collector-Residential 'D'



Local 'E'



Local 'F'



Divided Residential Subdivision Entrance

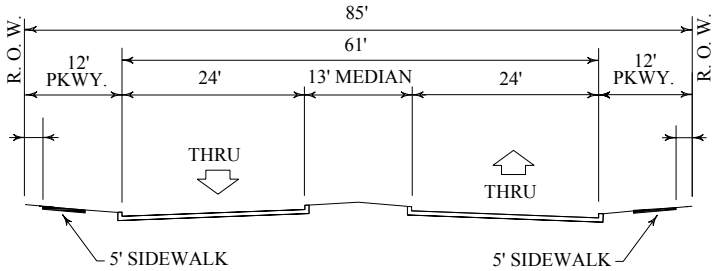


FIGURE 6.2: Cross Sections for Thoroughfare Types C through F and Divided Residential Subdivision Entrance

TABLE 6.2: Minimum Horizontal Centerline Radius

Design Speed V (MPH)	f	e(ft/ft)	R (ft) (Rounded for Design)
25	--	--	250(1)
30	--	--	450
35	0.155	-0.02	670
40	0.150	-0.02	850
45	0.145	-0.02	1,050
50	0.140	-0.02	1,400

(1) May be reduced to two hundred feet (200') radius at mid-block locations provided that it is shown that the general public safety is not compromised. A curve, with a radius less than two hundred fifty feet (250'), must be a minimum of three hundred feet (300') from a street or alley intersection.

D. Minimum Vertical Alignment:

1. Vertical curves are utilized in roadway design to affect gradual change between tangent grades and will result in design which is safe, comfortable in operation, pleasing in appearance and adequate for drainage. Vertical curve alignment shall also provide Stopping Sight Distance (SSD) in all cases. SSD is a function of design speed, perception-reaction time, grade, and dynamic friction. The perception-reaction time is assumed to be 2.5 seconds as stated by American Association of Highway and Transportation Officials (AASHTO). The dynamic friction is the force that resists movement of the vehicle while the tires are in a locked position. The equation for SSD appears below:

$$SSD = 1.47PV + \frac{V^2}{30(f+g)}$$

where:
SSD = stopping Sight Distance (ft); P = perception Reaction Time (2.5 sec.); V = vehicle design speed (MPH); f = coefficient of friction between tires and roadway; g = percent grade divided by 100

2. To determine the minimum acceptable length of Crest and Sag curves shown in Tables 6.3 and 6.4, it is assumed that g=0 in the SSD calculation. Tables 6.3 and 6.4 also show values of K. K is defined as the rate of vertical curvature and is equivalent to the horizontal distance in feet required to make a one percent (1%) change in grade. The values of A are equivalent to the algebraic difference in grade between the two grades that are being joined together by the vertical curve.

TABLE 6.3: Minimum Acceptable Crest Curve Given Speed and Difference in Grade of Road

Design Speed, V (MPH)	SSD (ft)	K	Length of Vertical Curve (L=KA)									
			A=1.2(1)	A=2	A=3	A=4	A=5	A=6	A=7	A=8	A=9	A=10
25	150	20	--	50	60	80	100	120	140	160	180	200
30	200	30	--	60	100	120	150	180	210	240	270	300
35	250	50	--	100	150	200	250	300	350	400	450	500
40	325	80	50	160	240	320	400	480	560	640	720	800
45	400	120	50	240	360	480	600	720	840	960	1080	1200
50	475	160	50	320	480	640	800	960	1120	1280	1440	1600

(1) Speeds less than forty miles per hour (40MPH), no vertical curve is necessary. Speeds greater than forty miles per hour (40MPH), use length of fifty feet (50').

TABLE 6.4: Minimum Acceptable Sag Curve Given Speed and Difference in Grade of Road

Design Speed, V (MPH)	SSD (ft)	K	Length of Vertical Curve (L=KA)									
			A=1.2[(1)]	A=2	A=3	A=4	A=5	A=6	A=7	A=8	A=9	A=10
25	150	30	--	60	90	120	150	180	210	240	270	300
30	200	40	--	80	120	160	200	240	280	320	360	400
35	250	50	--	100	150	200	250	300	350	400	450	500
40	325	70	50	140	210	280	350	420	490	560	630	700
45	400	90	50	180	270	360	450	540	630	720	810	900
50	475	110	50	220	330	440	550	660	770	880	990	1100

(1) Speeds less than forty miles per hour (40MPH), no vertical curve is necessary. Speeds greater than forty miles per hour (40MPH), use length of fifty feet (50').

E. Standard Intersection Layout:

1. Street intersections shall intersect at ninety degree (90°) angles. Intersection approaches for Type A and B thoroughfares shall remain perpendicular for a minimum distance equal to the corresponding design speed Stopping Sight Distance (SSD) identified in Table 6.3. For residential collector and/or local street intersections, a five degree (5°) tolerance is allowable.

2. The curb radii shall be twenty feet (20') where Type D, E and F thoroughfares intersect with Type D, E and F thoroughfares. All other intersecting streets, curb radii shall be thirty feet (30').

3. Type A-A, A-B, and B-B intersections shall maintain a maximum slope of two percent (2%) a minimum distance of two hundred feet (200') upstream and downstream of the intersection.

4. Roadway connections to a Type A or B thoroughfare shall maintain a maximum slope of two percent (2%) a minimum distance of one hundred feet (100') upstream and downstream of the intersection.

5. Separate grading plan shall be provided for Type A-A, A-B, and B-B intersections.

6. At four-way intersections of parabolic streets, the reduction of the crown height shall occur on the thoroughfare with the through gutter.

   a. For Type C and D thoroughfares, the crown height reduction from six inches (6") to three inches (3") shall occur through the intersection and transition from the curb return to a point fifty feet (50') past the curb return.

   b. Type E thoroughfare, the crown height reduction from four inches (4") to two inches (2") shall occur through the intersection and transition from curb return to a point thirty feet (30') past the curb return.

   c. Type F thoroughfare, the crown height reduction from five inches (5") to three inches (3") shall occur through the intersection and transition from curb return to a point thirty feet (30') past the curb return.

7. Alley curb radii shall be fifteen feet (15').

8. A minimum of nine and a half feet (9.5') of parkway shall be maintained from the back of the curb along the curb's radius.

9. ROW width for a Type A thoroughfare that intersects a Type A or B thoroughfare shall be one hundred forty feet (140') for a distance of two hundred feet (200') and then taper at a 15:1 ratio to the standard ROW width. This allows for the future construction of additional traffic lanes at the intersection. See Figure 6.3.

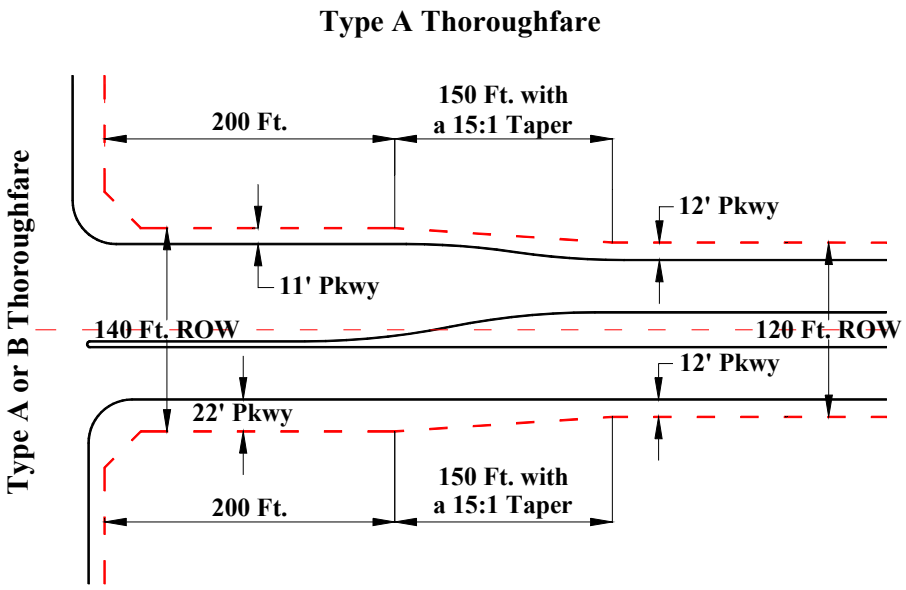


FIGURE 6.3: Major Intersection Detail

10. ROW width for a Type B thoroughfare that intersects a Type A or B thoroughfare shall be one hundred ten feet (110') for a distance of one hundred fifty feet (150') and then taper at a 15:1 ratio to the standard ROW width to allow build-out of the intersection. See Figure 6.4.

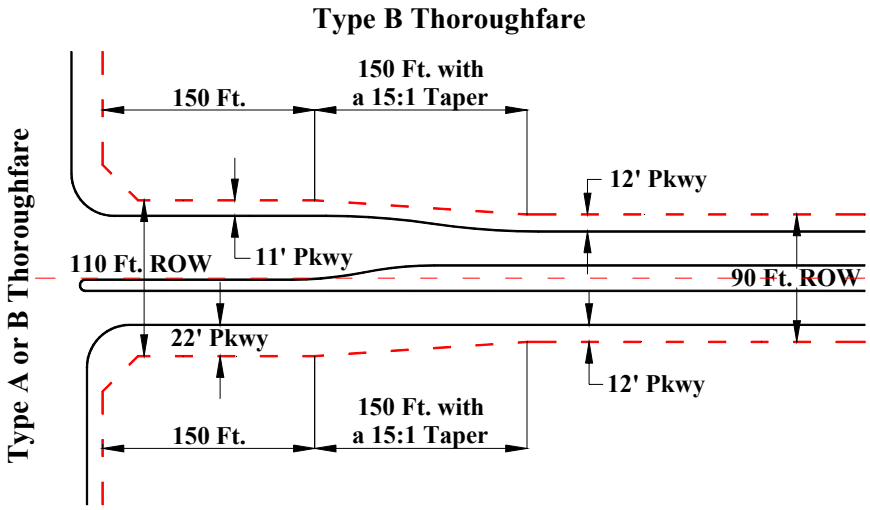


FIGURE 6.4: Minor Intersection Detail

F. Residential Frontage - Residential houses shall not front a Type A, B, or C thoroughfare unless parallel access roads are provided. Minimum distances between adjacent curbs of the thoroughfare and the access road shall be twenty feet (20'). Access road ROW shall be in addition to the thoroughfare ROW and shall not connect to the adjacent thoroughfare.

G. Bike Lane Consideration – If a thoroughfare is designated as a bike route, the width of the outside lane and the width of the ROW shall be increased by three feet (3') on Type A and B thoroughfares. For federal funding, five feet (5') may be required.

6.03 MEDIAN, LEFT-TURN LANE, RIGHT-TURN LANE, DECELERATION LANE AND ISLAND DESIGN:

A. Required Median Openings and Left-Turn Lanes:

1. Median openings on divided thoroughfares shall be required at all street intersections. Median openings may be constructed to serve non-residential drives provided that the minimum spacing requirements listed are met. Left-turn lanes shall be provided at all median openings.

2. 2. All non-residential lots on a divided thoroughfare shall have direct or indirect access to a median opening. Indirect access shall be provided through a series of fire lane and access easements. Multifamily developments, on a divided thoroughfare, shall have direct access to a median opening. Median openings for street intersections and non-residential driveways may be moved at the discretion of the City to facilitate traffic flow as long as minimum distances are maintained as per Sections 6.03.B.4 and 6.03.B.5.

B. Minimum Left-Turn Storage, Transition Length, and Median Opening Width, Location, and Spacing Requirements:

1. Left-Turn Lane Storage:

a. All left-turn storage areas on divided thoroughfares shall be ten feet (10') wide.

b. Storage requirements listed in Table 6.5 are absolute minimums. Storage requirements may be increased by the City based upon actual and projected traffic demands of the properties, which will be served by the left turn lane.

c. Left-turn lanes will be delineated by using buttons.

d. Concrete pavers shall be used in the median when the median width measured from back of curb to back of curb is a distance of six feet (6') or less.

2. Transition Length - The transition specifications for left-turn lane entrance areas are specified in Table 6.5. The variables used for the specification are shown in Figure 6.5.

TABLE 6.5: Minimum Left-Turn Lane Design Requirements

Type of Thoroughfare On	Type of Thoroughfare At	Turn Lane Width(s) (ft)	Length of Full-Width Turn Lane(ft)	Transition Specifications		
				Length(ft)	R_1(ft)	R_2(ft)
A	A, B	10(1)	150,250(2)	200	505	505
B	A, B	10	150	100	250	250
A, B	C, D	10	150	100	250	250
A, B	E, F	10	100(3)	100	250	250
A, B	Non-Residential Driveway	10	150	100	250	250
TxDOT	A Through F and Non-Residential Driveway	See TxDOT Specifications				
NTTA Service Road	A Through F and Non-Residential Driveway	See City of Frisco Standards				

(1) Double Left-Turn Lanes
(2) 150' – Inside Left-Turn Lane; 250' – Outside Left-Turn Lane
(3) 150' stacking shall be required for gated communities.

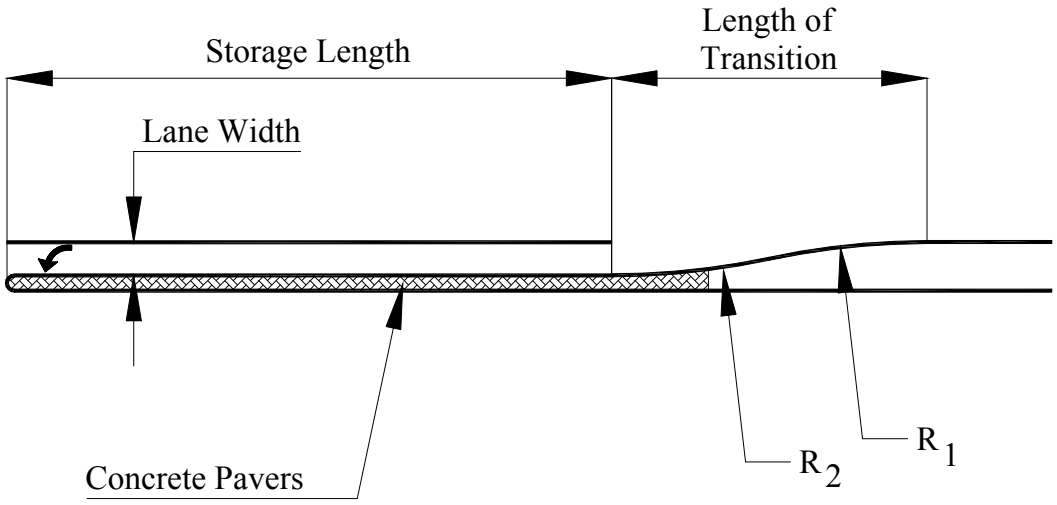


FIGURE 6.5: Typical Left-Turn Lane Dimensions

3. Median Openings:

   a. Median openings at intersections shall accommodate all turning paths and crosswalks.

   b. The width of mid-block median openings shall not be less than sixty feet (60'). They may be greater than sixty feet (60') where necessary to accommodate turning paths and crosswalks subject to approval by the City Engineer or his/her designee.

4. Minimum Spacing Between Intersections and First Mid-Block Median Opening on Divided Thoroughfares - The minimum distance to the first mid-block median opening along Type A and B thoroughfares that are immediately downstream from a Type A or B thoroughfare are shown in Figure 6.6. These distances vary from three hundred fifty feet (350') to four hundred feet (400') nose to nose depending on the thoroughfare type and the type of mid-block opening.

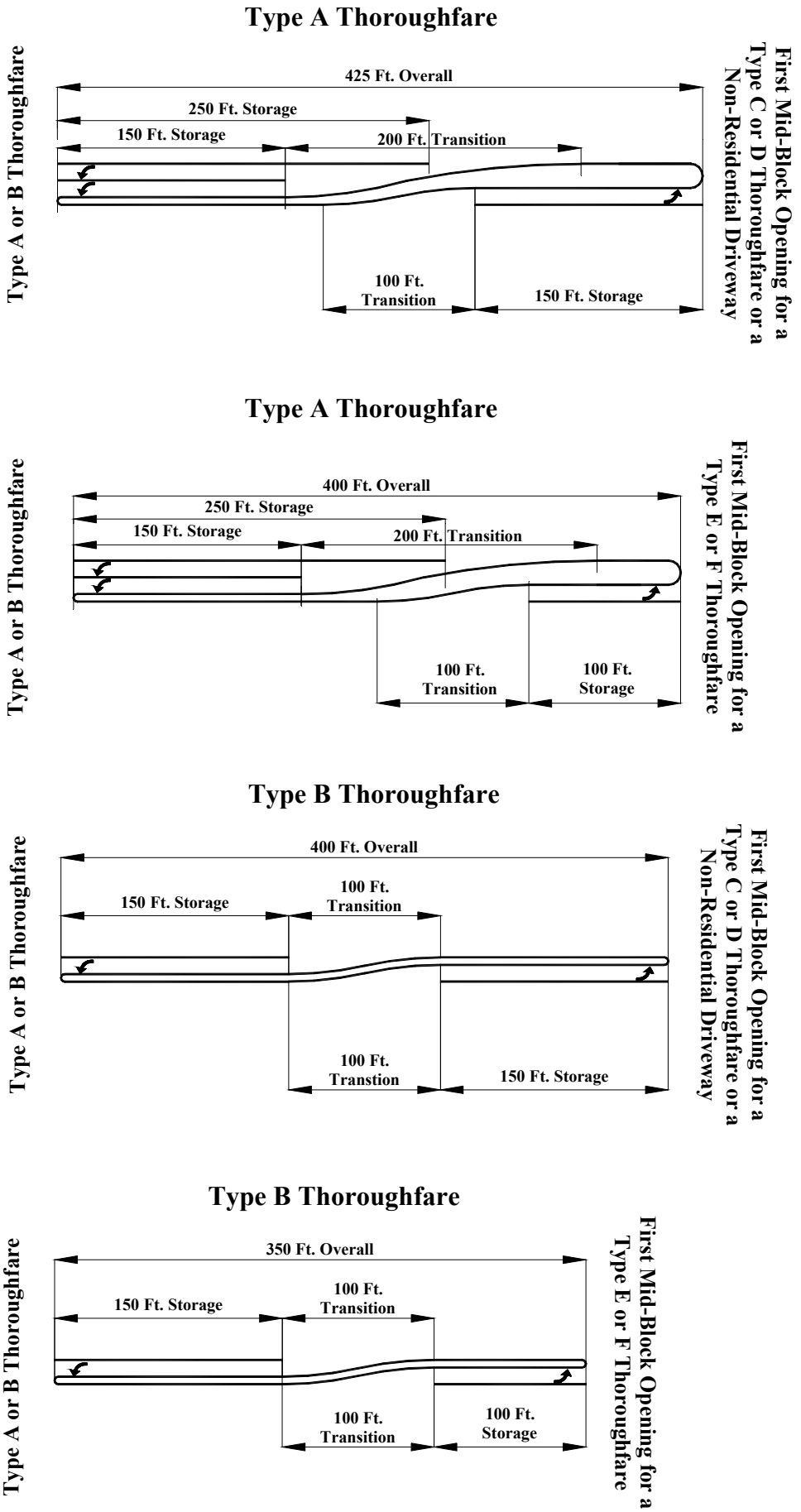


FIGURE 6.6: Minimum Spacing Between Types A or B Thoroughfares and First Mid-Block Median Opening on a Type A or B Thoroughfare.

4. 5. Minimum Distance Between Mid-Block Median Openings for Types C, D, E, and F Thoroughfares and Driveways along Divided Thoroughfares - The minimum distance between median openings on a Type A and B thoroughfares where left-turn storage is provided in both directions for Types C, D, E, and F intersecting thoroughfares and driveways is shown in Figure 6.7. The distances shown are measured nose to nose. Refer to Table 6.10 for driveway design requirements.

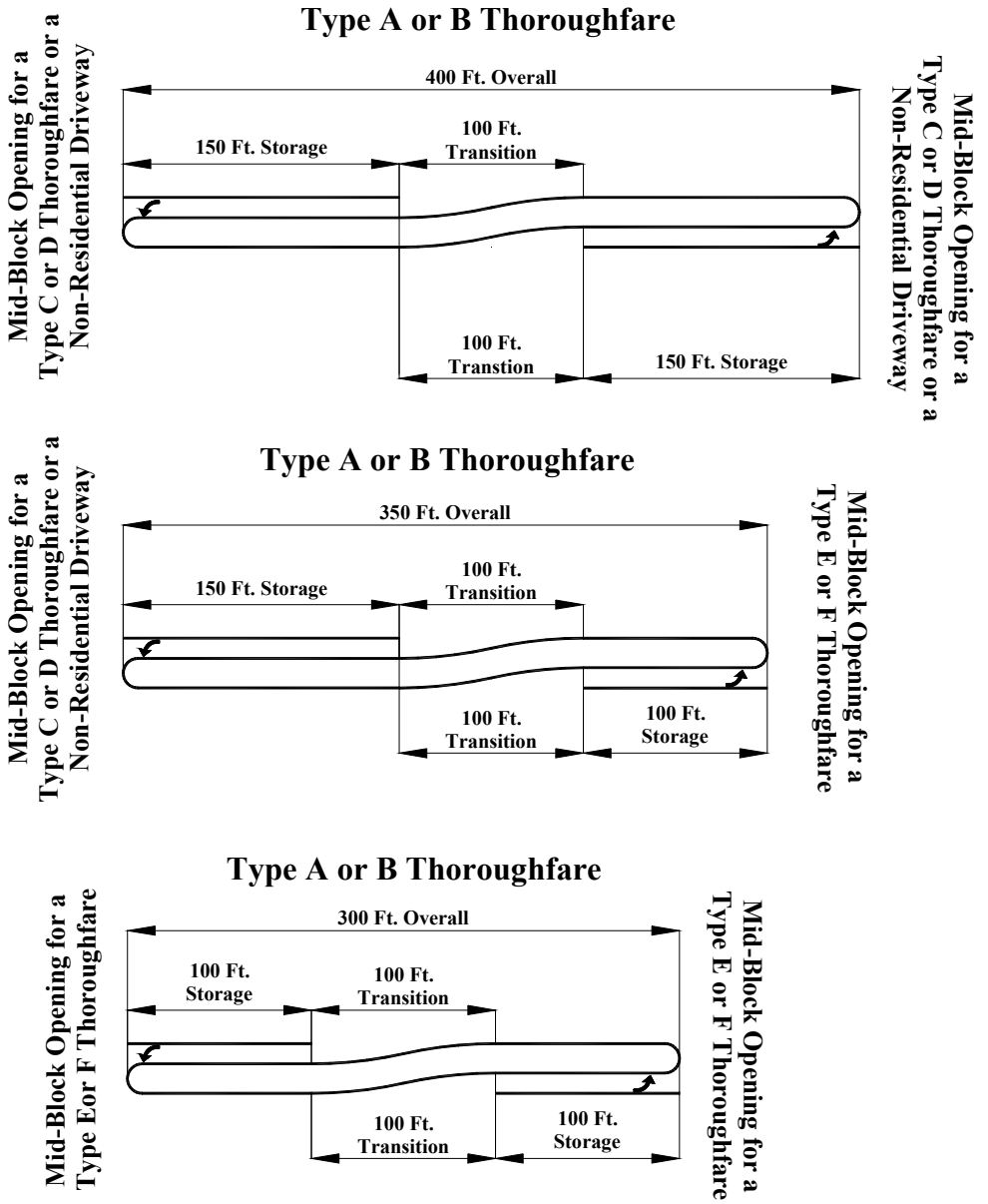


FIGURE 6.7: Minimum Distance Between Mid-Block Median Openings on a Type A or B Thoroughfare

6. Medians Where No Left-Turn Lane is Needed:

a. The minimum length of median shall be the sum of the required left-turn storage, transition length, ten-foot (10') tangent and length of median nose. This requirement is reflected in Figure 6.8. This is allowed, provided that access is not compromised for vacant property on the opposite side of the street.

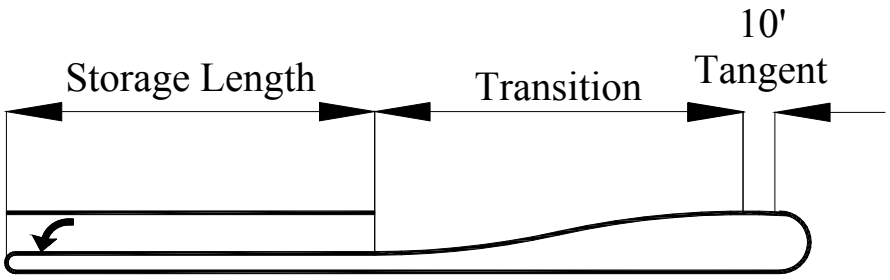


FIGURE 6.8: Minimum Length of Median Where No Left-Turn Lane is Needed

b. If the left-turn storage is not required in either direction, but the median is simply a spacer between two median openings, the minimum length of the spacer must be one hundred feet (100') (see Figure 6.9). A minimum spacing of one hundred feet (100') from the median opening to the first non-residential driveway shall be maintained.

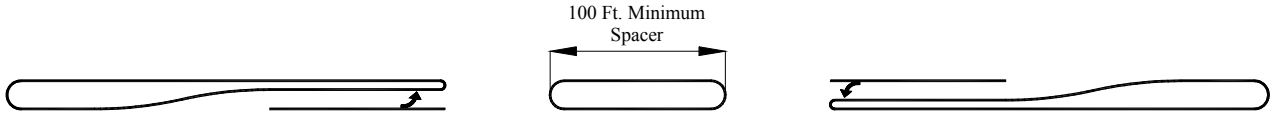


FIGURE 6.9: Minimum Spacer Length

c. If driveway is not served by a left-turn lane, then seventy-five feet (75') of separation shall be provided from edge of driveway to the median opening.

5. 7. Medians on Public Street Entrances to Developments:

a. Medians installed on undivided streets at entrances to subdivisions for aesthetic or any other purpose shall be a minimum of thirteen feet (13') wide and one hundred feet (100') long (See Figure 6.2 for Divided Residential Subdivision Entrance cross section).

b. In areas where a divided subdivision entry is constructed, the transition to the normal residential street width shall begin upstream or downstream of the first street intersection. No part of the transition shall occur within the intersection.

c. Alternative design standards may be required for these types of subdivision entries if they are located within special overlay districts defined by the City.

C. Minimum Right-Turn Storage and Transition Length:

(6) 1. Right-Turn Lane Storage:

a. Right-turn lanes on Type A and B thoroughfares intersecting with Type A and B thoroughfares shall be provided as warranted by traffic demands. At all other intersections on Type A and B thoroughfares, right-turn lanes shall be constructed at time of development.

b. All right-turn storage areas shall be eleven feet (11') wide.

c. An additional ten feet (10') of ROW shall be provided with right-turn lanes.

d. Right-turn lanes will be delineated by using buttons.

e. Storage requirements listed in Table 6.6 are absolute minimums. Storage requirements may increase based upon actual and projected traffic demands.

f. A tangent section of ten feet (10') shall be provided from the preceding driveway curb return to the transition of a right-turn lane.

2. Transition Length – The transition specifications for right-turn lane entrance areas are specified in Table 6.6. The variables used for the specification are shown in Figure 6.10.

TABLE 6.6: Minimum Right-Turn Lane Design Requirements

Type of Thoroughfare On	Type of Thoroughfare At	Turn Lane Width(s) (ft)	Length of Full-Width Turn Lane(ft)(1)	Transition Specifications(2)		
				Length(ft)	R_1(ft)	R_2(ft)
A	A, B	11	200	150	515	515
B	A, B	11	150	150	515	515
A, B	C, D	11	150	110	280	280
A, B	E, F	11	100	110	280	280
TxDOT	A Through F	See TxDOT Specifications				
NTTA Service Road	A Through F	See City of Frisco Standards				

(1) Measured from the intersecting thoroughfare ROW.
(2) No driveways are permitted within the transition area.

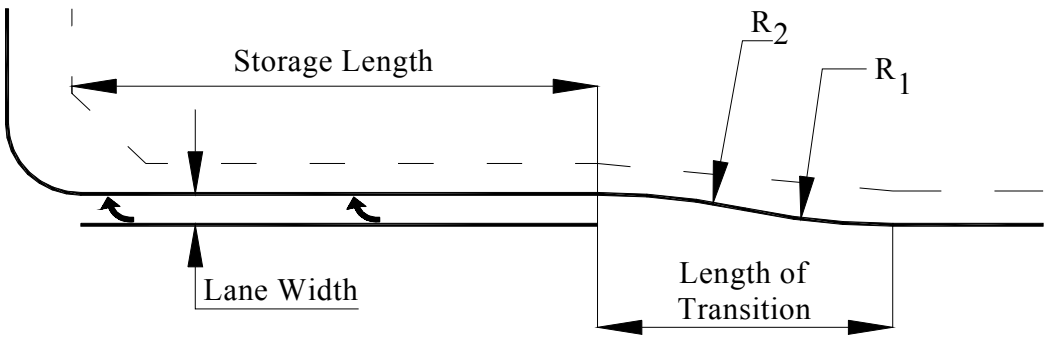


FIGURE 6.10: Typical Right-Turn Lane Dimensions

D. Minimum Deceleration Lane Storage and Transition Length:

1. Deceleration Lane Storage:

   a. Deceleration lanes shall be provided on Type A and B thoroughfares at all non-residential driveways, except the first driveway downstream of a Type A or B intersection.

   b. All deceleration lane storage areas shall be eleven feet (11') wide.

   c. Ten feet (10') of street easement, adjacent to ROW, shall be provided with deceleration lanes.

   d. Deceleration lanes will be delineated by buttons.

   e. Storage requirements listed in Table 6.7 are absolute minimums. Storage requirements may increase based upon actual and projected traffic demands.

   f. A tangent section of ten feet (10') shall be provided from the preceding driveway curb return to the transition of a deceleration lane.

2. Transition Length - The transition specifications for deceleration lane entrance areas are specified in Table 6.7. The variables used for the specification are shown in Figure 6.11.

TABLE 6.7: Minimum Deceleration Lane Design Requirements

Type of Thoroughfare On	Type of Thoroughfare At	Turn Lane Width(s) (ft)	Length of Full-Width Turn Lane(ft)(1)	Transition Specifications		
				Length(ft)	R_1(ft)	R_2(ft)
A	Non-Residential Driveway	11	80	110	280	280
B	Non-Residential Driveway	11	60	110	280	280
TxDOT	Non-Residential Driveway	See TxDOT Specifications				
NTTA Service Road	Non-Residential Driveway	See City of Frisco Specifications				

(1) Measured from the curb return of the driveway.

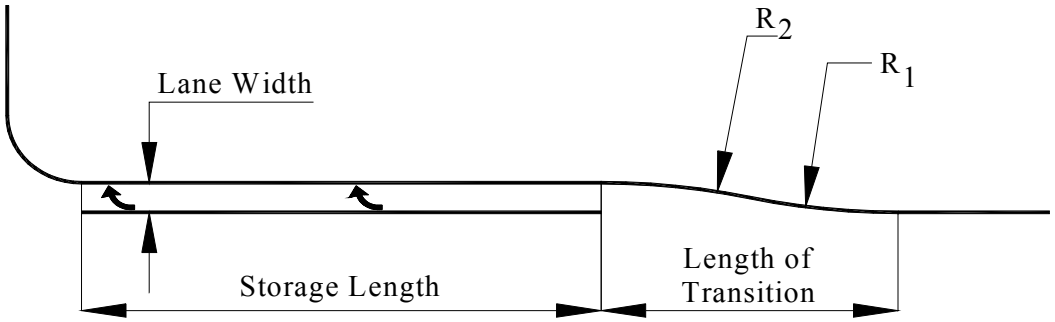


FIGURE 6.11: Typical Deceleration Lane Dimensions

E. Cost of Median Openings and Turn Lanes:

1. Median openings, left-turn lanes, and right-turn lanes constructed for residential streets and/or subdivision entrances not referenced on the Thoroughfare Plan shall be the responsibility of the developer and shall be paved to City standards and inspected by the City.

2. Median openings, left-turn lanes and deceleration lanes for Multifamily and non-residential developments shall be the responsibility of the developer and shall be paved to City standards and inspected by the City.

3. The City shall require escrow of funds for such future improvements prior to final acceptance or Certificate of Occupancy, whichever occurs first. The escrow shall include all construction costs; engineering (7% of construction cost) and inspection (2.5% of construction cost).

6.04 ALLEY AND SERVICE ROAD DESIGN:

A. Alley Intersections:

1. Alleys shall not intersect any Type D thoroughfare or higher class.

2. Alleys that are parallel to and share a common ROW line with a Type D or above thoroughfare shall turn away from the Type D or above thoroughfare not less than one subdivision lot width or a minimum of forty feet (40') (whichever is greater) from the cross street as shown in Figure 6.12.

3. A minimum of forty feet (40') between ROW lines or one subdivision lot width (whichever is greater) shall be maintained in the case where an alley intersects a street that is in close proximity to an adjoining street intersection (See Figure 6.12).

4. All alley intersections with streets shall be perpendicular or radial, within a five degree (5°) tolerance, at the intersection of the ROW lines.

5. Alley offsets along residential streets shall be less than fifteen feet (15') or greater than seventy-five feet (75') measured from alley centerline to alley centerline.

6. Alleys shall not align with existing streets such as to create a four-way intersection.

7. Alleys shall not align across from future streets to create an intersection.

8. Internal alley to alley intersections shall be offset, from the centerline, a minimum of one hundred feet (100').

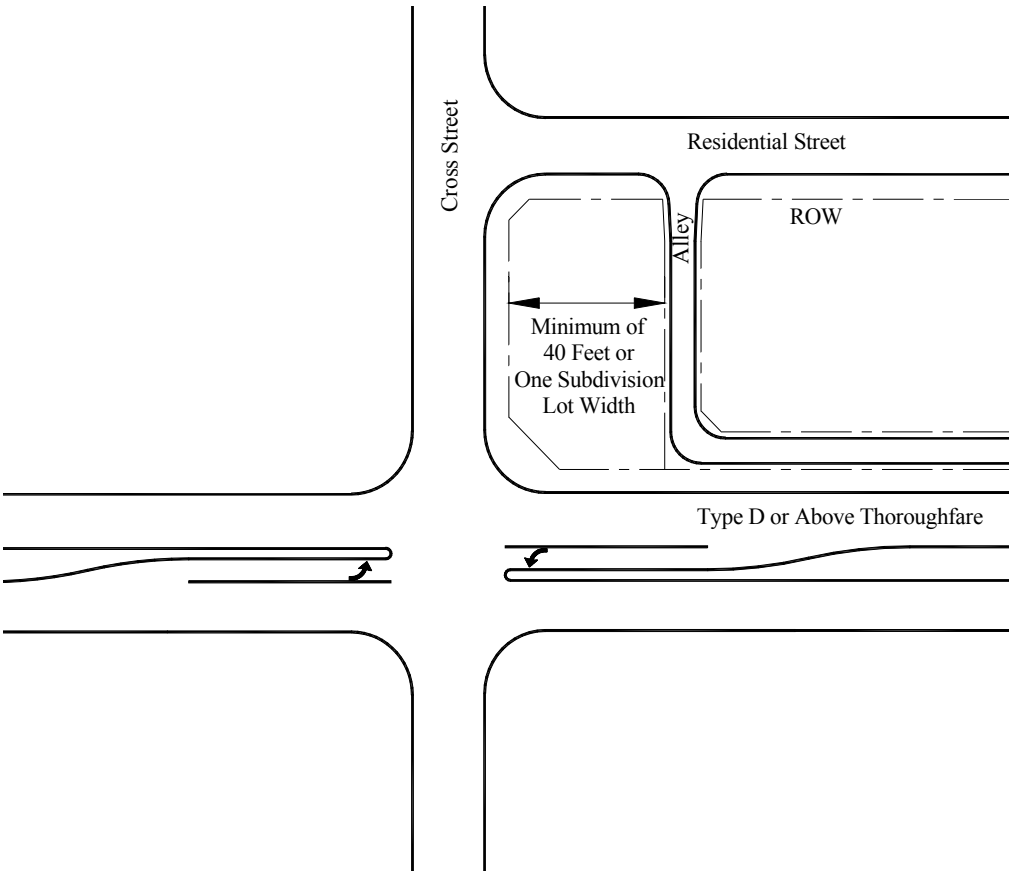


FIGURE 6.12: Minimum Distance from Intersection for Parallel Alley

B. Alley Radius - Alley radii at street intersections shall not be less than fifteen feet (15') (See Figure 6.13).

1. Alley Intersecting Alley Radius – The radius shall be measured from the ROW and vary based upon the alley ROW intersection angle listed in Table 6.8.

TABLE 6.8: Alley Intersecting Alley Radius

Alley ROW Intersection Angle	Minimum Required ROW Radius (ft)
1°-40°	70
41°-70°	50
71°-90°	40
> 90°	50

C. Alley ROW Width- The alley ROW width shall be eighteen feet (18').

D. Alley Pavement Width - The alley pavement width shall be twelve feet (12') except near street intersections as shown in Figure 6.13.

E. Alley Pavement Thickness – The thickness shall be 8"–5"–8" with pavement strength and reinforcement as required in Section 6.02.(B.5).

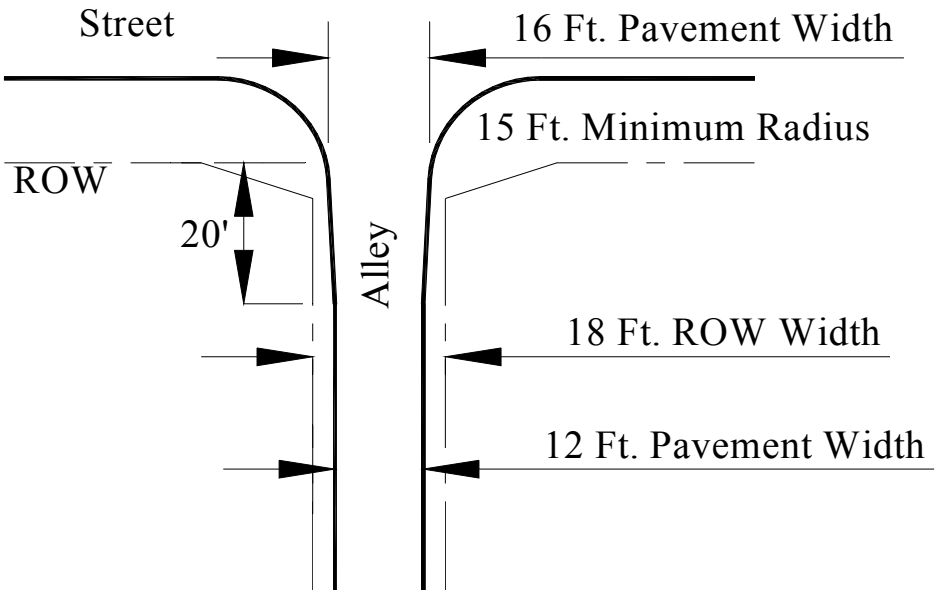


FIGURE 6.13: Alley Dimensions

F. Rear Alley Frontage - The minimum alley rear frontage shall be twenty feet (20').

G. Alley Speed Limits - The speed limit in alley ways shall be ten miles per hour (10MPH).

H. Alley Visibility Obstructions:

1. No fence, wall, screen, sign, structure, or foliage of hedges, trees, bushes, or shrubs shall be erected, planted or maintained in any alley ROW.

2. Foliage of hedges, trees, bushes, and shrubs planted adjacent to the alleys ROW shall be maintained such that the minimum overhang or encroachment shall be fourteen feet (14') above the alley surface one foot (1') outside the edge of the pavement.

6.05 DRIVEWAY DESIGN:

A. Introduction - Driveway design standards are needed to provide safe and efficient vehicular access to and from the public street system, to provide public street capacity for accommodating peak traffic volumes of public streets, to maintain smooth traffic flow, and to maintain street ROW and drainage. The intent of driveway design standards is to achieve the following:

1. Prohibit the indiscriminate location and spacing of driveways while maintaining reasonable vehicular access to and from the public street system.

2. Reduce conflicting turning movements and congestion thereby reducing vehicular accidents.

3. Maintain and enhance a positive image for the attraction of new, high quality, residential and non-residential development in the City.

4. Provide right-turn and deceleration lanes for all streets and driveways along Type A and B Thoroughfares, North Dallas Tollway service roads and State Roadways. (Deceleration lanes are required on Preston Road (SH289) for driveways served by median openings.)

B. Definition of Driveway Types:

1. Residential Driveway - Provides access to a single-family residence, duplex, or multifamily building containing four or fewer dwelling units. These drives shall intersect Type D, E, and F thoroughfares only.

2. Non-Residential Driveway:

   a. Commercial Driveway - Provides access to an office, retail or institutional building, or multifamily building having more than four dwelling units. It is anticipated that such buildings will have incidental truck service. Commercial drives shall access Type A through Type C thoroughfares only. Exceptions for residential connections are specified in the Comprehensive Plan.

   b. Industrial Driveway - Serves truck movements to and from loading areas of an industrial facility, manufacturing, warehouse, or truck terminal. A retail development may have one or more driveways specially designed, signed, and located to provide access for trucks. These types of driveways shall be considered industrial driveways. Industrial plant driveways whose principle function is to serve administrative or employee parking lots shall be considered commercial driveways. Industrial drives shall access Type A through Type C thoroughfares only.

3. Standard Driveway - Provides two-way access at a single, undivided curb opening.

4. One-Way Driveway - Provides inbound or outbound access and can only be permitted when the orientation of on-site circulation and parking layout clearly utilize the driveway for one-way movements.

5. High Capacity Driveways - Intended to provide two-way access with geometric provisions which more adequately respond to greater driveway volumes and/or access limitations than standard driveways. These provisions include increased width and/or internal storage. Median divider and/or deceleration lanes may also be required.

C. General Design Parameters:

1. The centerline angle for a driveway approach shall be ninety degrees (90°) to the street curb line for all driveways.

2. Driveways shall not be permitted in the transition area of any right-turn lane or deceleration lane.

3. Driveways that intersect at a mid-block median shall have the driveway centerline intersect with the midpoint of a median opening (measured nose-to-nose).

4. Driveway restrictions can be required by the City Engineer to ensure adequate circulation.

5. Driveway elevations at the ROW line shall be a minimum of six inches (6") above the street gutter. A residential driveway that intersects an alley shall be three inches (3") above the edge of the alley pavement at the ROW line.

6. Cross access is required between adjacent retail, office and commercial properties.

7. Driveway grades in a fire lane shall not exceed six percent (6%) either longitudinally or laterally to accommodate emergency vehicle access. Steeper grades may be permitted in areas where buildings are not present, as approved by the Engineering Department and the Fire Department.

8. Differential grades on driveways shall not exceed twelve percent (12%).

D. Driveway Width - The width of a driveway refers to the width of pavement at the property line and is measured where the curb return radii ends perpendicular to the street curb or edge of pavement. The minimum and maximum widths of driveways are listed in Table 6.9.

TABLE 6.9: Minimum and Maximum Driveway Widths

Driveway Type	Land Use	Width in Feet (face to face)	
		Minimum (ft)	Maximum(ft)
Standard Drive	Residential	10	24
	Commercial/Multifamily	24	30
	Industrial	30	40
One-Way Drive	Residential (circular)	10	16
	Commercial	16	24
	Industrial	24	24
High Capacity Drive for Non-residential Uses	Entrance Lane	16	24
	Exit Lane: One	12	16
	Two	24	24
	Three	30	30
Driveway Medians (non-residential/multifamily uses)		4	11

Notes:

1. A residential driveway width of thirty-two feet (32') may be allowed to an alley if the garage faces onto the alley.
2. The maximum width for service station driveways shall be forty feet (40').
3. Driveways that serve as a fire lane shall be a minimum of twenty-four feet (24') in width.

E. Driveway Radius:

1. All driveways intersecting dedicated streets shall be built with a circular curb radius connecting the six-inch (6") raised curb of the roadway to the design width pavement of the driveway.

2. Driveway radii shall fall entirely within the subject property so as to begin at the street curb, at the extension of the property line.

3. Table 6.10 presents the minimum and/or maximum standards to be applied in designing and locating driveways on public streets.

4. High capacity driveways shall meet the same standards as those defined in Table 6.10.

F. Driveway Spacing:

1. Driveways shall be spaced at distances sufficient to ensure that conflicting movements at adjacent driveways do not overlap.

2. Spacing between driveways should be measured along the property line from the edge of one driveway to the closest edge of the next driveway and not from centerline to centerline.

3. Table 6.10 defines minimum driveway spacing as a function of street classification.

4. The driveway spacing from a railroad crossing shall be a minimum of fifty feet (50') from the railroad ROW.

TABLE 6.10: Driveway Design Requirements

Criteria	Thoroughfare Classification	Residential Driveway (ft)	Commercial/ Multifamily Driveway (ft)	Industrial Driveway (ft)
Driveway Curb Radius	Major "A"	--	20-30	20-30
	Minor "B"	--	20-30	20-30
	Commercial Collector "C"	--	20-30	20-30
	Residential Collector "D"	5-10	20	--
	Local "E" / "F"	5-10	--	--
Minimum Driveway Spacing Along Roadway (edge to edge)	Major "A"	--	240	240
	Minor "B"	--	200	200
	Commercial Collector "C"	--	90	90
	Residential Collector "D"	20	max. of 1 drive	--
	Local "E" / "F"	20	--	--
Minimum Distance to Intersection Along Roadway (edge to intersecting ROW)[1]	Major "A"	--	75 / 100[2]	75 / 100[2]
	Minor "B"	--	75 / 100[2]	75 / 100[2]
	Commercial Collector "C"	--	50 / 50	50 / 50
	Residential Collector "D"	20 / 20	100 / 100	--
	Local "E" / "F"	10 /10 from tangent to edge of drive	--	--

(1) upstream / downstream distance to intersection. (See Figure 6.14)
(2) driveway without a deceleration lane shall be located a maximum distance of one hundred seventy feet (170') to the downstream edge from the intersecting ROW.

4. A residential land use shall be allowed a maximum of one (1) driveway opening per lot, tract, or parcel except as provided by the approval of a circular driveway.

5. To minimize the number of curb cuts along public drives, joint or shared access is encouraged. Shared access drives shall conform to the following standards:

   a. Residential: no less than ten feet (10') on each property (20' min. – 24' max.).

   b. Commercial/Industrial: no less than twelve feet (12') on each property (24' min – 36'max).

   c. Joint access drives for commercial/industrial developments shall include full drive width and access pavement and be built at the same time for a development.

   d. The spacing and location of driveways shall be related to both existing adjacent driveways and those shown on approved development plans.

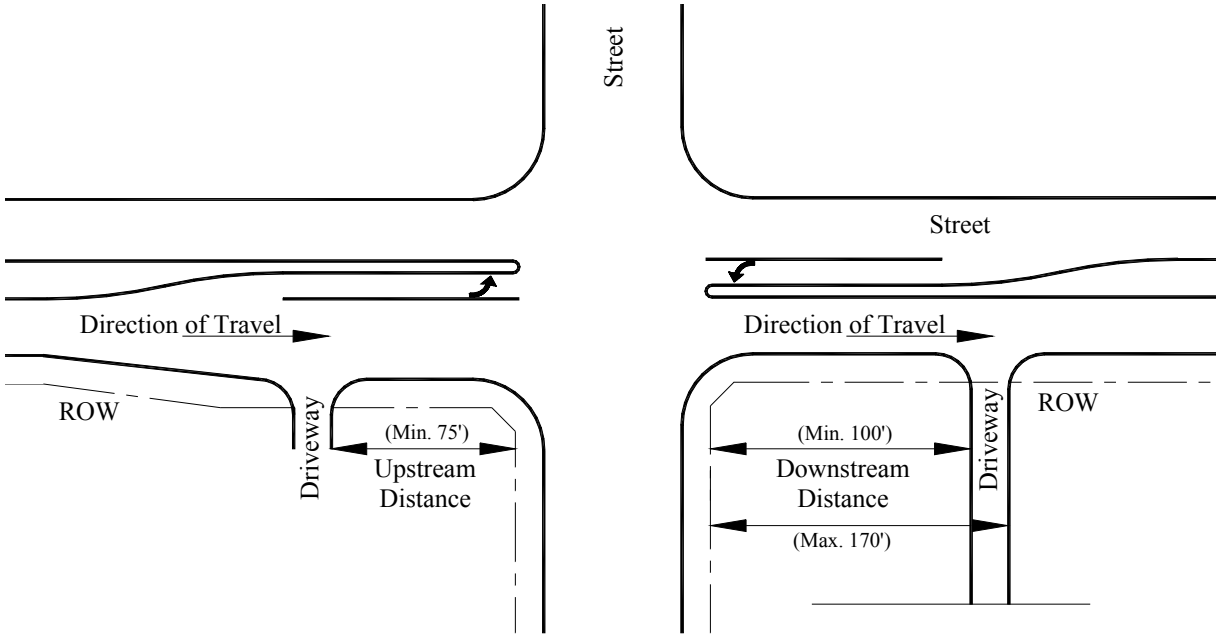


FIGURE 6.14: Distance Between Driveway and Intersection

G. Distance Between Driveway and Intersection:

1. Adequate distance between cross street intersections and access drives shall be provided to ensure intersection/driveway conflict areas are minimized.

2. Table 6.10 defines the upstream and downstream distance from an intersection as a function of street classification.

H. Deceleration Lanes:

1. Deceleration lanes for right-turns into driveways will ease the negative impact a driveway will have on traffic flow, driveway conflict points and safety due to speed differential.

2. A driveway located within the right-turn lane of a public street intersection shall be extended a minimum of seventy-five feet (75') in advance of the intersecting ROW.

3. No driveway shall be permitted within the transition area of a right-turn or deceleration lane, unless otherwise approved by the City Engineer. If allowed, transition for right-turn or deceleration lane shall be extended a maximum of fifty feet (50').

4. The developer shall be responsible for the design, ROW adjustment of utilities, and construction costs of any auxiliary and deceleration lane required as a condition of a driveway permit.

5. A ten-foot (10') street easement shall be provided for deceleration lanes for non-residential developments.

6. Refer to Table 6.7 for deceleration lane design standards.

I. Driveway Storage Lengths:

1. On-site internal storage shall be provided at all non-residential and multifamily driveways for queuing of vehicles off-street, to minimize congestion, and increase safety both on the public street and within the driveway.

2. Internal storage requirements shall be based on the total number of parking spaces accessible by the affected driveway.

3. Internal storage length shall be measured from the ROW line to the first intersecting aisle or parking stall.

4. Table 6.11 presents internal storage requirements.

TABLE 6.11: Minimum Driveway Storage Lengths

Parking Spaces per Driveway	Storage Required (ft)			
	Multifamily / Commercial Uses		Industrial Land Uses	
	Non-Median Opening	Median Opening	Non-Median Opening	Median Opening
Less than 25	25	25	25	25
25-50	25	40	25	40
51-100	25	40	40	40
101-200	40	80	40	60
More than 200	100	150	40	100

J. Driveways for Gated Developments:

1. Residential/Multifamily:

a. Gated developments shall have a median divided street that will allow for a vehicular turn-around prior to the gate in the event that access is denied.

b. The turn-around shall be a minimum of eighteen feet (18') in width.

c. Entry gates shall be set back from the ROW a minimum of one hundred thirty-five feet (135') to provide stacking to the card reader or first stop a minimum of one hundred feet (100') to allow the longest queue of vehicles expected to access the gate.

3. d. The drives shall be a minimum of twenty-four feet (24') in width with driveway curb radii of thirty feet (30'). See Figure 6-15.

e. The hinge point of the gate shall be a minimum of eighteen inches (18") behind back of the curb. The gate shall open to twenty-four inches (24") behind back of curb.

f. Gates shall be equipped with both opticom and knox box for emergency access.

g. Gates shall not encroach on sidewalks.

h. Any alternative designs require specific staff approval.

2. Other Non-Residential:

   a. Gated developments shall have a median separating ingress and egress traffic flow allowing for a vehicular turn-around prior to the gate in the event that access is denied.

   b. The turn-around shall be a minimum of eighteen feet (18′) in width.

   c. Entry gates shall be set back from the ROW or fire lane a minimum of seventy-five feet (75′) to provide stacking to the card reader or first stop a minimum of forty feet (40′) to allow the longest queue of vehicles expected to access the gate.

   d. The drives shall be a minimum of twenty-four feet (24′) in width with driveway curb radii of thirty feet (30′). See Figure 6-15.

   e. The hinge point of the gate shall be a minimum of eighteen inches (18″) behind back of the curb. The gate shall open to twenty-four inches (24″) behind back of curb.

   f. Gates shall be equipped with both opticom and knox box for emergency access.

   g. Gates shall not encroach on sidewalks.

   h. Alternate standards may be required based on Traffic Impact Analysis (TIA).

3. Individual gated single-family residences - Shall have a minimum setback of twenty feet (20′) from the property line.

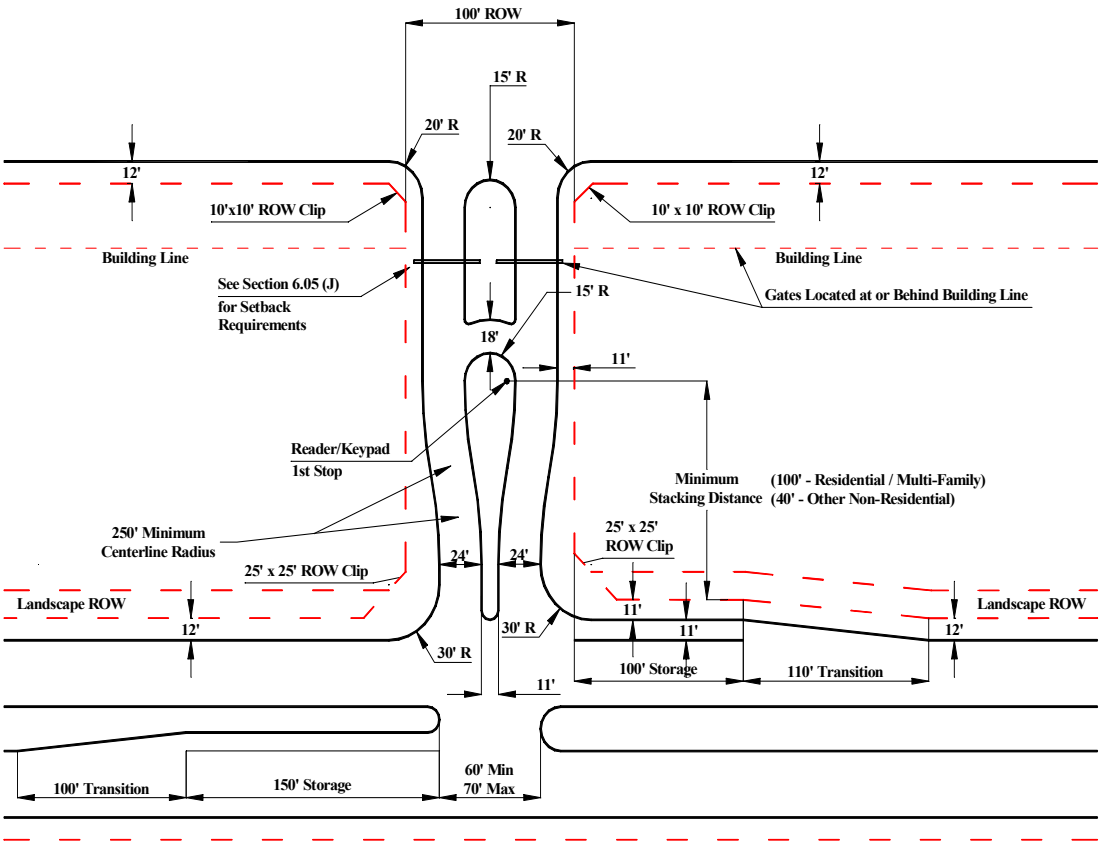


FIGURE 6.15: Gated Entrance Detail

K. Non-Conforming Driveways:

1. All nonconforming driveways on a lot, tract, parcel or site shall be allowed to continue until the occurrence of one or more of the following events:

   a. A change in use, or an increase in intensity of use, occurs such that the site requires a ten percent (10%) increase in required parking spaces.

   b. Addition or expansion of required stacking spaces.

   c. Any modification that changes the design or function of the existing driveway.

   d. The addition of a median opening on the public street by a developer. All driveways that are served by the new median opening shall comply with the requirements of these standards.

2. Upon the occurrence of the events described, the nonconforming status of the driveway shall cease and the driveway either reconstructed in accordance with this ordinance, or eliminated.

6.06 SIDEWALK AND LOCATION DESIGN:

A. Definition of Sidewalk - A sidewalk is defined as that paved area in a street ROW between the curb lines or the edge of pavement of the roadway and the adjacent property lines for the use of pedestrians. The maximum grade of the sidewalk shall be one-half-inch (1/2") per foot. The maximum cross-fall of the sidewalk shall be one-quarter-inch (1/4") per foot. Sidewalks shall conform to ADA requirements, that currently exist, and to the following standards:

1. Zoning Classification Requiring Sidewalks - Concrete sidewalks designed and located according to City standards shall be constructed along all streets in all zoning classifications except agriculture uses in agricultural zoned areas. Non-residential and multifamily sidewalks shall be built at the time of lot development. Should it be impractical to install the sidewalk at that time, funds for the sidewalk construction shall be placed in escrow with the City for use when the City determines sidewalks are needed. Payment of such escrow shall be made prior to final acceptance of residential uses or certificate of occupancy for non-residential and multifamily uses.

2. Residential Areas (Single Family, Duplex, and Townhome) - A concrete sidewalk, six feet (6′) in width, shall be located within the street ROW on all Type A & B thoroughfares. A two-foot (2′) sidewalk easement will be required on all Type A & B thoroughfares. A concrete sidewalk, five feet (5′) in width, shall be located within the street ROW on all Type C, D, E, and F thoroughfares, adjacent to ROW line with a two-foot (2′) sidewalk easement on Type F thoroughfares unless pre-existing physical encroachments (e.g., utility infrastructure or trees) dictate otherwise. Sidewalks and parkways (curb to ROW) shall be graded at one-quarter-inch (1/4″) per foot above the top of the street curb. Sidewalks for residential lots shall be constructed by the homebuilder.

3. Non-Residential Areas and Apartment Complexes - A concrete sidewalk, six feet (6′) in width, shall be located within the street ROW on all Type A & B thoroughfares. A two-foot (2′) sidewalk easement will be required on all Type A & B thoroughfares. A concrete sidewalk, five feet (5′) in width, shall be located within the street ROW on all Type C, D, E, and F thoroughfares, adjacent to ROW line with a two-foot (2′) sidewalk easement on Type F thoroughfares unless pre-existing physical encroachments (e.g., utility infrastructure or trees) dictate otherwise. If other materials are placed in the ROW between the sidewalk and curb, the material shall meet City specifications and be of a color and texture distinctly different from the sidewalk and specified on the site plan.

4. Meandering Sidewalks - Sidewalk easements adjacent to the standard ROW will be required, if necessary, for meandering sidewalks. The rear edge of the sidewalk closest to the street shall be located not less than five feet (5′) from the back-of-curb and shall meander into the sidewalk easement. Sidewalk easements shall provide a minimum clearance of two feet (2′) beyond the rear edge of the sidewalk.

5. Exceptions - If it should be necessary to construct the walk immediately adjacent to the street curb line or within five feet (5′), the walk shall be a minimum of six feet (6′) in width. At no time shall the side of the walk away from the street be less than five feet (5′) away from the curb line. If the required sidewalk is to be placed outside of the street ROW, it must be placed in a sidewalk easement. Approval of planned exceptions and sidewalk easements shall be made at the time of site plan or plat approval.

6. Areas with Screening Walls - In areas where a screening wall is provided, a meandering sidewalk shall be provided and shall not encroach any closer than eighteen inches (18″) from the wall.

7. Sidewalks on Bridges - All street bridges shall have a sidewalk constructed on each side of the bridge. The sidewalk shall be a minimum of six feet (6′) wide with a parapet wall provided a minimum of two feet (2′) behind the curb of the thoroughfare. A standard pedestrian bridge rail protecting the sidewalk shall be provided on the outside edge of the bridge. See Figure 6.16.

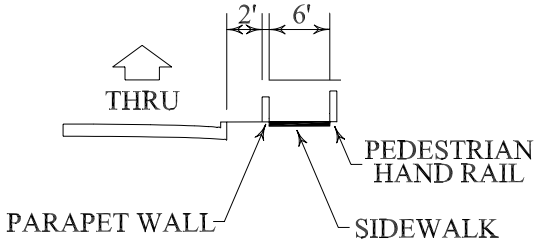


FIGURE 6.16: Bridge Parapet Wall and Pedestrian Rail

8. Sidewalks Under Bridges - When new bridges are built as a part of the construction of a roadway or the reconstruction of a roadway and a pedestrian crossing is needed, an eight-foot (8′) sidewalk will be built as a part of the embankment design underneath the bridge structure.

9. Sidewalks on Culverts – All culvert crossings shall have a sidewalk constructed on each side of the culvert. The sidewalk shall be a minimum of six feet (6′) wide with a standard pedestrian hand rail as shown in Figure 6.16 provided on the outside edge of the culvert. Parapet wall may be required by the Engineering Department.

10. Access to Cul-de-sacs from Adjacent Streets - To promote a pedestrian friendly environment, a sidewalk shall be provided between cul-de-sacs and adjacent streets.

6.07 PUBLIC RIGHT-OF-WAY VISIBILITY REQUIREMENTS:

A. Adequate sight distance at the intersection of a thoroughfare and a proposed thoroughfare/driveway/alley must be ensured. This sight distance is provided through the use of a Corner Visibility Triangle and/or a Sight Line Triangle. Corner Visibility Triangles shall be dedicated as ROW and Sight Line Triangles shall be identified and dedicated as Visibility, Access and Maintenance Easements (VAM's). In addition, a Sight Line Triangle must also be provided for the following cases:

1. Where a driveway, alley, or any thoroughfare that is controlled by a stop sign intersects with an uncontrolled thoroughfare.

2. On any signalized intersection approach where right-turn on red operation is permitted, a sight line triangle must be provided for the right turn driver.

B. Corner Visibility Triangle Defined:

1. The corner visibility triangle is defined at an intersection by extending the two ROW lines for from their point of intersection to a distance as shown on Table 6.12. These two points are then connected with an imaginary line to form the corner visibility triangle as shown in Figure 6.17. If there are no curbs existing, then the triangular area shall be formed by extending the property lines for a distance of thirty feet (30') from their point of intersection.

TABLE 6.12: Corner Visibility Triangle Distances

Type of Thoroughfare On	Type of Thoroughfare At	Distance (X)
A, B	A Through F	25'
C	C, D	25'
C	E, F	10'
D, E, F	D, E, F	10'
TxDOT, NTTA	TxDOT, NTTA, A Through F	25'

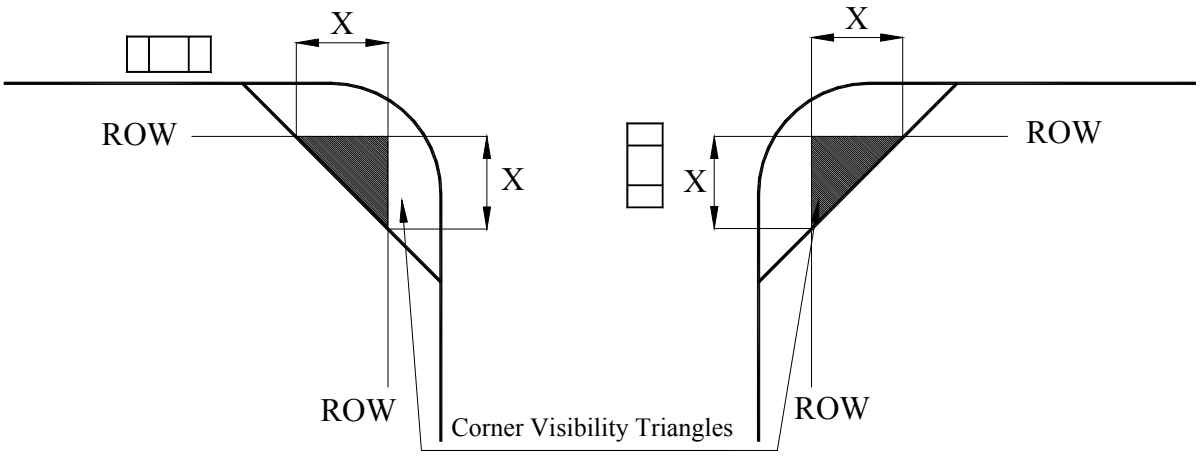


FIGURE 6.17: Corner Visibility Triangle for an Intersection

2. Where alleys intersect residential Type E and F thoroughfares, the corner visibility triangle is measured as fifteen feet (15') along the residential street ROW and five feet (5') along the alley ROW from the point of intersection. These two points are then connected with an imaginary line to form the corner visibility triangle as shown in Figure 6.18. The alley corner visibility triangle shall be dedicated as ROW.

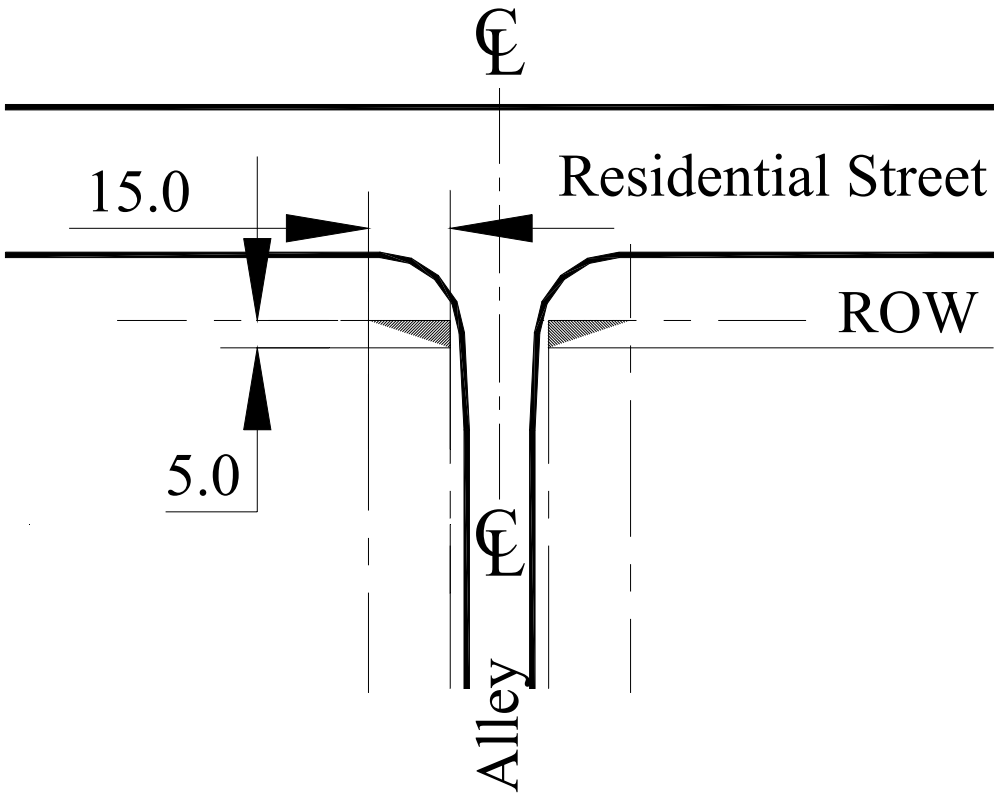


FIGURE 6.18: Corner Visibility Triangle for an Alley

4. 3. Street intersections designed under the neo-traditional concepts shall have a lesser corner visibility triangle along the curb lines as determined by the City Engineer or his/her designee.

C. Sight Line Triangle Defined:

1. The sight line triangle is formed by first extending a line along the center line of the proposed thoroughfare or drive that begins at the tangent curb of the intersecting thoroughfare and extends to its endpoint fifteen feet (15') into the proposed thoroughfare or driveway. For the sight line triangle to the left, construct a second imaginary line that is parallel to and five feet (5') out from the intersecting thoroughfare's curb that begins at the centerline of the side street and continues to the left for a distance L to its endpoint. To complete the sight line triangle, connect the endpoints of the first two lines as shown in Figures 6.19 and 6.20. In the case of the sight line triangle to the right, the second imaginary line is parallel and five feet (5') out from the nearest edge of the conflicting traffic flow (or adjacent median in the event of a divided thoroughfare). It begins at the centerline of the side street and continues to the right for a distance R to its endpoint (See Figures 6.19 and 6.20).

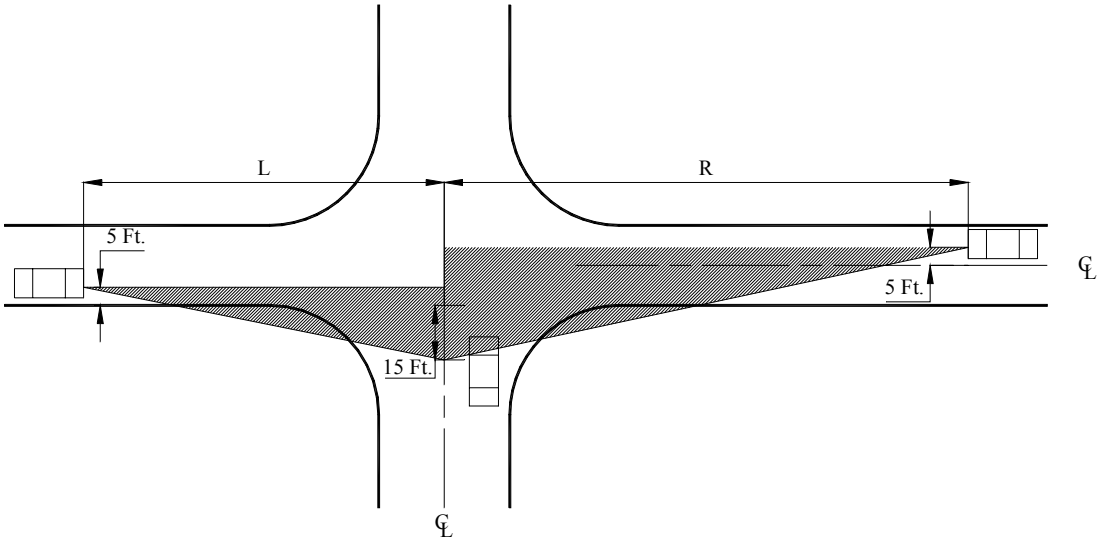


FIGURE 6.19: Sight Line Triangle

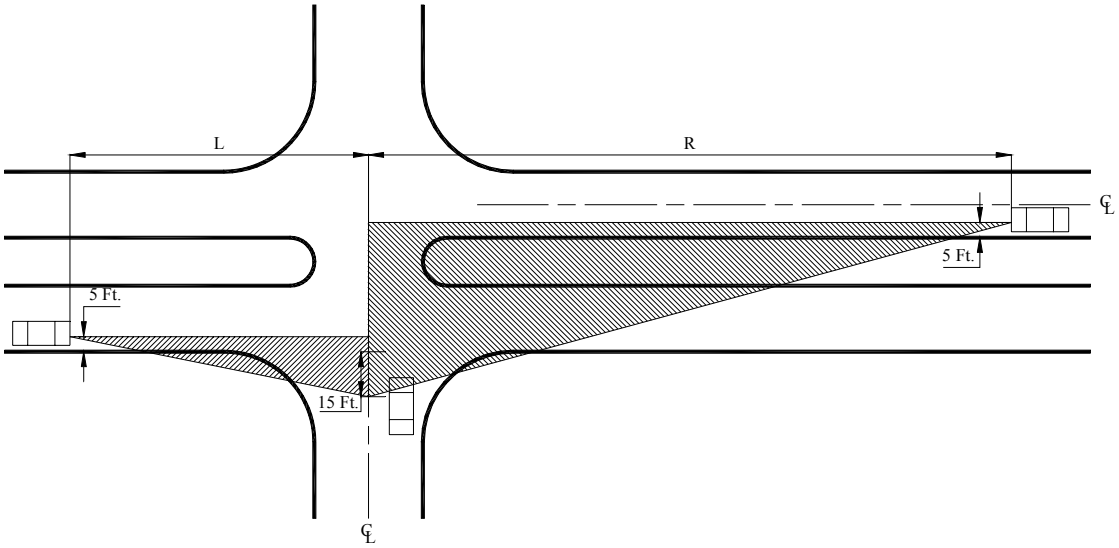


FIGURE 6.20: Sight Line Triangle for a Divided Thoroughfare

2. Distance to driver's eye for driveways that intersect a street is fifteen feet (15') from the intersecting curb line as shown in Figures 6.19 and 6.20.

3. In the case where the thoroughfare contains existing horizontal curvature, the distances L and R must be measured along the horizontal curve.

TABLE 6.13: Sight Line Triangle Distances

Design Speed V (MPH)	SD to Left[(1)] L (ft)	SD to Right by Lanes in Cross Section R (ft)		
		2	4[(2)]	6[(2)]
25	275[(3)]	275[(3)]	N/A	N/A
30	325	325	N/A	N/A
35	425	425	N/A	N/A
40	525	525	N/A	N/A
45	625	625	650	N/A
50	725	725	750	775

(1) Source AASHTO Green Book – Chapter 9.
(2) (2)Manual Calculations of the Procedure in the Green Book indicate a twenty-five-foot (25′) increase in sight distance to the right for each increase in cross section.
(3) 150′ with approval by the City Engineer or his/her designee.

D. Landscaping and Obstruction Requirements for Corner Visibility and Site Line Triangles:

1. No fence, wall, screen, sign, structure, foliage, hedge, tree, bush, shrub, berm, driveways, parking, drive aisles, or any other item, either man-made or natural shall be erected, planted, or maintained in a position that will obstruct or interfere with a driver's clear line of sight within both the corner visibility and sight line triangle (i.e., VAM's).

2. Vision at all intersections where streets intersect at or near right angles shall be clear at elevations between thirty inches (30″) and nine feet (9′) above the average gutter elevation within each triangle.

E. Landscape Plan Requirements:

1. A landscape plan is required that shows the plan/profile of the street on both sides and the median where necessary of each proposed drive/street to the proposed development with the grades, curb elevations, proposed street/drive locations, and all items (both natural and man-made) within both the corner visibility and sight line triangles.

2. This landscape plan shall be provided with all site plans and engineering plans that are submitted for review/approval. This profile shall show no horizontal or vertical restrictions (either existing or future) within the corner visibility and sight line triangles.

3. All landscape plans shall show all items as prescribed by the Parks and Recreation Department and Planning Department.

F. Rights-of-Way Obstructions Outside the Site Line Line Triangles:

1. Fences, walls, screens, signs and other structures shall conform to the Comprehensive Zoning Ordinance of the City as amended, and to the Sign Ordinance of the City.

2. Foliage of hedges, trees and shrubs in ROW which are not governed by Frisco's Comprehensive Zoning Ordinance, or the above triangles shall be maintained such that the minimum overhang above a sidewalk shall be seven feet (7′) and the minimum overhang above a street shall be fourteen feet (14′).

3. All other areas within ROW shall be clear at elevations between thirty inches (30″) and nine feet (9′) above the average gutter.

4. Plants in the ROW that will grow over thirty inches (30") (when mature) above the adjacent street's curb shall conform to all of the above requirements, where applicable. All landscape plans shall show all items as prescribed by the Parks and Recreation Department and Planning Department, including:

    a. The locations and type of such plants.

    b. The prescribed corner visibility and sight line triangles.

    c. Ground elevations or spot elevations as necessary, to avoid conflicts, will be shown by contour lines within both triangles.

    d. No plantings or berms over thirty inches (30") above the adjacent gutter elevation are allowed in the median for the length of the left turn storage area unless specifically agreed upon by the City Engineer or his/her designee.

    e. Single trunked trees within the triangles and in the median shall be allowed and spaced so as to not cause a "picket fence" effect. Because of the large variation of ways in which trees can be planted, the spacing shall be decided upon by City Engineer or his/her designee and the developer at the time of review of the landscape plans. Any other item that obstructs these lines so as to interfere with the above requirements shall not be allowed.

G. Abatement:

1. The City Engineer or his/her designee shall have the authority to determine whether any such fence, wall, screen, hedge, tree, bush, shrub, sign or structure, as erected, planted or maintained, constitutes a public hazard or public nuisance in violation of the provision of this ordinance. Upon determination, he shall cause to be issued a written notice to the owner or lessee of the property demanding that corrective action be taken within ten (10) days of the date the notice is mailed.

2. The City of Frisco may abate the hazard or nuisance, which affects the public's health, safety and general welfare, upon the written request of the owner or lessee of the property and upon payment of reasonable charges for labor.

3. Under extreme conditions, the City Engineer or his/her designee may require immediate corrective action.

H. Exceptions - The provisions of the Thoroughfare and Circulation Design Requirements shall not apply to, or otherwise interfere with, the following:

1. Placement and maintenance of traffic control devices under governmental authority and control.

2. Existing and future City, State and Federal Regulations.

6.08 TRAFFIC CALMING GUIDELINES:

A. Introduction:

1. Traffic Calming, a concept that dates back to the 1960's and 70's, has been implemented more extensively throughout the United States during the 1990's. The primary purpose of traffic calming is to decrease speeds and reduce cut-through traffic volumes. The Institute of Transportation Engineers (ITE) defines traffic calming as:

"Traffic Calming is the combination of mainly physical measures that reduce the negative effects of motor vehicle use, alter driver behavior and improve conditions for non-motorized street users."

2. Urban sprawl and traffic congestion continue to increase in the United States. As a result, speeds and cut-through volumes on local streets and collectors will continue to increase unless traffic calming measures are put in place or new local and collector thoroughfares are designed with traffic calming in mind.

3. The Thoroughfare and Circulation Design Requirements and Subdivision Ordinance are intended to provide design and access requirements that are proactive in addressing traffic calming issues in residential areas. In instances where problems exist that can be addressed by traffic calming, a specific process will be used to identify the problem and potential solutions.

4. Traffic control devices such as STOP Signs and speed limit signs are regulatory measures that require enforcement. Traffic calming measures, however, are intended to be self-enforcing.

B. Traffic Calming Process - The traffic calming process contains steps that include the three E's commonly found in traffic calming programs. These E's are Education, Enforcement and Engineering. In many instances, applying the Education and Enforcement steps will solve the problem without implementing a more costly engineering solution. The traffic calming process will use the following steps:

1. Neighborhood must identify a problem and bring it to the City's attention with a petition signed by 80% of the property owners along the street.

2. The City will conduct a study to determine the extent of the reported problem.

3. The City will examine the results of study.

4. If the study indicates that a problem exists, the City will identify if there are additional stakeholders in solving the problem. These additional stakeholders will typically include emergency services and the school district.

5. If speeding problem exists, the City will then:

   a. Identify possible causes.

   b. Work with the neighborhood to raise awareness to the problem (Education).

   c. Increase the enforcement level after the education process (Enforcement).

   d. Conduct another study to determine if Education and Enforcement have solved the problem.

   e. If a speeding problem still exists, the City will then:

      (i) Determine best traffic calming measure to apply (Engineering).

      (ii) Determine whether the solution should be a temporary installation or permanent installation.

      (iii) Conduct an after study to see if the measure has had the desired effect.

6. If a cut-through problem exists, the City will then:

    a. Identify possible causes.

    b. Examine the area roadway network to determine the best solution.

    c. Work with surrounding neighborhoods to implement a solution. This step is necessary because traffic calming measures that address this problem may move the cut-through traffic to another neighborhood street.

    d. Conduct an after study to determine if the solution was effective.

C. Role of Emergency Services and School District – The process must involve Fire and Rescue, Police and the School District (bussing). It is recommended that these agencies play an advisory role. Some measures may delay emergency response time. It is imperative that each neighborhood realizes that this is a trade-off when implementing traffic calming measures. All traffic calming measures must be designed to accommodate emergency vehicles and school buses.

D. Traffic Calming Measures – Below is a list of traffic calming solutions for speed related problems and cut-through traffic problems. The solutions are listed in no particular order.

1. Potential Solutions for Speed Related Problems:

    a. Chokers – midblock

    b. Neckdowns – at intersection

    c. Neighborhood speed watch program

    d. Realigned intersections

    e. Medians

    f. Traffic circles/roundabouts

    g. Lateral shifts

    h. Textured pavements

    i. Chicanes

Note: STOP signs are not intended for speed control. Studies have shown that installation of STOP signs to control speed actually increase the speeds measured at midblock locations downstream from the STOP sign.

2. Potential Solutions for Cut-Through Traffic Related Problems:

    a. Diverters

    b. Median barrier

    c. Turn restrictions

6.09 FRONTAGE ROAD DESIGN:

A. Frontage roads are typically found adjacent to existing or planned freeway type facilities.

B. Frontage roads are considered Type A thoroughfares and should be designed to the Type A standards set forth in this document.

C. Access to frontage roads shall also conform to the standards set forth for Type A thoroughfares. In addition the following access restrictions apply to frontage road design:

1. Exit Ramp Restrictions:

a. No driveway shall be located less than fifty feet (50') in advance of the concrete curb gore of an exit ramp.

b. No driveway shall be located less than four hundred feet (400') beyond the concrete curb gore of an exit ramp.

2. Entrance Ramp Restrictions:

a. No driveway shall be located less than two hundred feet (200') in advance of the concrete curb gore of an entrance ramp.

b. No driveway shall be located less than fifty feet (50') beyond the concrete curb gore of an entrance ramp.

6.10 TRAFFIC SIGNAL DESIGN AND INSTALLATION REQUIREMENTS:

A. Introduction:

1. Traffic signals that are properly justified, designed, operated, and effectively located may result in one or more of the following:

a. Assign ROW to assure an orderly movement of traffic at an intersection.

b. Provide progression for a platoon of vehicles along a given route.

c. Interrupt heavy traffic to allow cross-street traffic and pedestrians to cross or enter the main street flow.

d. Increase the capacity of an intersection or certain traffic movements at the intersection.

e. Reduce the frequency of occurrence of certain types of accidents.

2. Although traffic signals may be warranted they may not always result in the desired effects listed above. If they are improperly designed, operated, or maintained and are not located in an effective manner they can:

a. Increase accident frequency (especially rear end accidents).

b. Cause excessive delay for motorists and pedestrians.

c. Disregard of signal indications.

d. Cause cut-through traffic on nearby collectors and residential streets

B. Warrant Criteria:

1. To justify the installation of a traffic signal, Part IV in the *Texas Manual of Uniform Traffic Control Devices* (TMUTCD) should be followed. It not only describes the warrants for a signal installation, but also provides guidelines and requirements for the actual design and operation of a traffic signal.

2. Engineering studies must be conducted in order to assess whether a particular location satisfies the warrant criteria listed in the TMUTCD. These studies may include one or more of the following:

   a. Traffic volume counts

   b. Pedestrian volume counts

   c. Delay studies

   d. Speed studies

   e. Gap studies

   f. Diagram of physical conditions

   g. Accident studies

3. The TMUTCD states the following concerning the evaluation of the warrant criteria.

   "Traffic control signals should not be installed unless one or more of the signal warrants in this manual are met. The satisfaction of a warrant or warrants is not in itself justification for a signal. Information should be obtained by means of engineering studies and compared with the requirements set forth in the warrants. The engineering study should indicate the installation of a traffic signal will improve the overall safety and/or operation of the intersection. If these requirements are not met, a traffic signal should neither be put into operation nor continued in operation (if already installed)."

C. Signal Spacing:

1. Signal spacing plays a very important part in being able to provide progressive flow for a platoon of traffic. Ideally, as the desired speed of a platoon increases, the signal spacing should also increase. Therefore, signal spacing on major thoroughfares should be larger than the signal spacing found on minor thoroughfares and collectors.

2. Factors that affect signal spacing include platoon speed and traffic signal cycle length. The platoon speed is the speed at which a group of vehicles travel between signalized intersections. The traffic signal cycle length is the time it takes for the traffic signal to complete a full sequence of signal indications. A summary of possible signal spacing requirements based on platoon speed and cycle length is shown in Table 6.14.

D. Emergency:

1. Opticom detectors shall be provided on all traffic signals for use by emergency vehicles.

E. Conduit:

1. Two (2) four-inch (4") conduit rings with pull boxes shall be installed around an intersection whenever a major thoroughfare, minor thoroughfare, or collector intersects a roadway having a status of collector or higher. These conduits shall be used for future traffic signal communications, video monitoring and communications for city services.

2. A two-inch (2") conduit with pull boxes shall be installed across median openings and intersections along every thoroughfare, Type B and above. This conduit shall be used for future street lighting.

TABLE 6.14: Sample Signal Spacing Requirements

Cycle Length (sec)	Platoon Speed (MPH)	Signal Spacing	
		Two-way Progression Pattern	
		Alternate	Double Alternate
60	30	1320	660
70	30	1540	770
80	30	1760	880
90	30	1980	990
100	30	2210	1100
110	30	2430	1210
120	30	2650	1320
60	35	1540	770
70	35	1800	900
80	35	2060	1030
90	35	2320	1160
100	35	2570	1290
110	35	2830	1410
120	35	3090	1540
60	40	1760	880
70	40	2060	1030
80	40	2350	1180
90	40	2650	1320
100	40	2940	1470
110	40	3230	1620
120	40	3530	1760
60	45	1980	990
70	45	2320	1160
80	45	2650	1320
90	45	2980	1490
100	45	3310	1650
110	45	3640	1820
120	45	3970	1980